Claims

[c1]   1.An apparatus for treating congestive heart failure com-

prising

a multi-electrode lead, said multi-electrode lead having

at least three selectable electrodes,

a cardiac stimulator in the body of said patient, said car-

diac stimulator being connected to said multi-electrode

lead,

means for selecting a subset of said electrodes for stim-

ulating the heart such that stimulation through said set

of electrodes improves cardiac performance, and

means for stimulating the heart through said subset of

electrodes.

[c2]   2.The apparatus of claim 1 further comprising means for

selecting a set of electrodes lying on the right septal

wall.

[c3]   3.The apparatus of claim 3 further comprising means for

stimulating substantially all of the ventricular septum

within at least the first 10 per cent of ventricular con-

traction time.

[c4]   4.The apparatus of claim 2 further comprising means for

stimulating at said set of electrodes to stiffen the septum in a sequence such that substantially all of the septum stiffens substantially simultaneously.

[c5]   5.The apparatus of claim 2 further comprising means for selecting a set of electrodes lying on the septal wall by identifying a set of electrodes close to a line connecting two electrodes that are known to lie on the septal wall.

[c6]   6.The apparatus of claim 1 wherein said multi-electrode lead has sufficient electrodes deployable on the right ventricular septal wall such that at least fifty per cent of the right ventricular wall could be stimulated within the first ten percent of the ventricular contraction time.

[c7]   7.The apparatus of claim 6 wherein said electrodes are within 8 mm of each other.

[c8]   8.The apparatus of claim 6 wherein the electrodes are within 4 mm of each other.

[c9]   9.The apparatus of claim 1 further comprising means for determining a three dimensional position for each electrode.

[c10]   10.The apparatus of claim 1 further comprising means for developing a plurality of template patterns of wave fronts passing said electrodes and means for distin-

guishing between intrinsic and ectopic wave fronts by comparing sensed wave fronts to said template patterns.

[c11]   11.An implantable cardiac stimulator for treating congestive heart failure comprising

an implantable lead having at least three electrodes,

a cardiac stimulator connectable to said lead to place said electrodes in electrical communication with said stimulator;

at least one detector coupled to said electrodes for detecting electrical phenomenon in the patient's body;

a timer connected to said detector for timing at least one elapsed time between electrical phenomena detected at said electrodes;

at least one logical template of an expected pattern of detected electrical phenomenon at said electrodes,

a comparator comparing said detected electrical phenomenon and said elapsed times associated with said phenomenon to said logical template, and

an output circuit providing a therapy to said patient in response to said comparison.

[c12]   12.The implantable cardiac stimulator of claim 11 further comprising a logical model in said cardiac stimulator representing locations of said electrodes in a patient's body.

[c13] 13. The implantable cardiac stimulator of claim 11 further comprising a time-out circuit, said time out circuit turning off said timer whenever a second electrical phenomenon has not occurred within a selected period of time after a first phenomenon.

[c14] 14. The implantable cardiac stimulator of claim 13 wherein the selected period of time is set based on electrode spacing and on expected conduction velocities.

[c15] 15. The implantable cardiac stimulator according to claim 11 further comprising a logical template of a normal pattern and at least one logical template of an ectopic pattern.

[c16] 16. The implantable cardiac stimulator according to claim 15 further comprising a circuit identifying an ectopic beat whenever a series of electric phenomenon is first detected at an electrode other than a selected first electrode.

[c17] 17. The implantable cardiac stimulator according to claim 16 further comprising memory storing a template for identified ectopic beats.

[c18] 18. The implantable cardiac stimulator of claim 11 further comprising circuit means for stimulating the heart through at least some of said at least three electrodes

and means for selecting as a stimulating electrode that electrode which produces a pattern of electric phenomenon most closely resembling a normal template.

[c19] 19. The implantable cardiac stimulator of claim 18 further comprising means for identifying fast conduction associated with stimulation through a patient's Purkinje system.

[c20] 20. The implantable cardiac stimulator of claim 18 further comprising means for measuring cardiac output and means for comparing relative cardiac output resulting from stimulation at each of said at least some electrodes and wherein said means for selecting a stimulating electrode is responsive to said means for measuring cardiac output to select as stimulating electrode the electrode optimizing cardiac output.